

THE DISTINCTION OF *CERAMIUM GIACCONEI* SP. NOV.
(CERAMIALES, RHODOPHYTA)
IN THE MEDITERRANEAN SEA FROM
CERAMIUM CINGULATUM

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ABSTRACT - The examination of the type specimen of *Ceramium cingulatum* Weber-van Bosse indicates that material from the Mediterranean Sea identified as that species is different and belongs to a new species here described: *Ceramium giacconei* sp. nov. The main features of this new species are: erect axes 1-2mm high, club-shaped, simple; cortication complete over all the thallus except in the lowermost part, where it is restricted to the nodes.

RÉSUMÉ - L'examen critique de l'exemplaire type du *Ceramium cingulatum* Weber-van Bosse montre que les spécimens méditerranéens, rapportés jusqu'à présent à cette espèce par plusieurs auteurs, sont différents de celle-ci. Ils appartiennent en réalité à une espèce nouvelle, *Ceramium giacconei* sp. nov., dont les caractères les plus importants sont: les axes dressés, hauts de 1 à 2mm, en forme de massue, non ramifiés; la cortication continue, sauf vers la base du thalle, où elle est limitée aux nœuds.

KEY WORDS : *Ceramium giacconei* sp. nov., *Ceramium cingulatum*, Ceramiaceae, Mediterranean Sea.

INTRODUCTION

The genus *Ceramium* Roth 1797 is well represented in the Mediterranean Sea. Feldmann-Mazoyer (1940), in her monograph of the Ceramiaceae for this sea, reported 14 species of *Ceramium* (some with different varieties) nearly all widely distributed within this area. In addition to these species, some others of doubtful taxonomic merit have to be added: *C. radiculosum* Grunow (Hauck, 1885), *C. leptocladum* Schiffner (Schiffner, 1931), *C. pleurosporum* Schiffner, *C. pseudostrictum* Schiffner, *C. vatovai* Schiffner (Schiffner, 1938), *C. hellenicum* Giaccone (Giaccone, 1968), as well as other species recorded more recently, viz: *C. fastigiatum* (Roth) Harvey (Boudouresque, 1984; Ribera, 1984); *C. fastigiatum* var. *flaccidum* (Borgesien) Petersen (Giaccone, 1978; Coppejans, 1983; Verlaque, 1984; Barceló, 1987); *C. fruticosum*

(Kützing) J. Agardh (Gallardo *et al.*, 1985); *C. deslongschampsii* Chauvin⁽¹⁾ (Gómez-Menor & Fuertes Lasala, 1982; Güven & Öztig, 1971; Aysel *et al.*, 1983).

Ceramium cingulatum Weber-van Bosse was first recorded from the Mediterranean Sea by Coppejans (1977, 1979 and 1983). This species was formerly known only from the Indian Ocean (Straits of Sapeh, Makassar: Weber-van Bosse, 1923; Tanzania: Jaasund, 1970; Somalia: Sartoni, 1974) and the South Chinese Sea (Pham-Hoang, 1969). More recently, it was recorded (with some doubt) by Verlaque & Tiné (1981) from Tolone and by Ballesteros (1984) and Barceló & Boisset (1986) from the Spanish Mediterranean coasts.

Ceramium cingulatum has been recently recorded also from Italy, along the Ionian coast of Sicily (Cormaci & Motta, 1989) as well as along the coasts of Lazio (Abdelahad & Biliotti, 1990) and Sardinia (Cecere, pers. comm.).

But Cormaci & Motta (1989) pointed out that their thalli (both those collected in field and those grown in culture), which were very similar to the species described and illustrated by Coppejans (1977, 1983) and Barceló & Boisset (1986) as *Ceramium cingulatum* (Fig. 10), are quite different from Weber-van Bosse's description of *Ceramium cingulatum* (Weber-van Bosse, 1923); so, they referred their thalli to this species with some doubt. In order to explain the above-mentioned taxonomic doubt, it has been considered opportune to carry out a study based on the examination of the type material of *Ceramium cingulatum*. This study permits us to conclude that the Mediterranean alga identified as *Ceramium cingulatum* represents a new species herein described.

MATERIALS AND METHODS

The following material has been studied:

Ceramium cingulatum Weber-van Bosse, type material, Makassar Sept. 1888. Rijksherbarium L. 8268 n. 1. The herbarium sheet has got another label where there is written: *Ceramium cingulatum* f. *major* on *Gracilaria*? But Weber-van Bosse (op. cit.) does not speak about any f. *major*; but on page 333 she indicated that she found on the thallus of an apparent *Gracilaria* additional *Ceramium cingulatum* that "...ne se distingueait du *Ceramium cingulatum*, étudié auparavant, que par sa plus grande taille".

Ceramium cingulatum on *Echinocaulon* (*Gelidiopsis*) *rigidum* collected at stat.: 49 (Makassar) by Weber-van Bosse. Rijksherbarium L. 8846 (in spirit). Only few thalli, not complete.

(1) However the occurrence of this species in the Aegean Sea is regarded as doubtful by Athanasiadis (1987).

Ceramium cingulatum: a specimen with spermatocysts⁽²⁾ without the basal portion (Fig. 18), collected by Sartoni at Sar Uanle (Somalia) in October 1972 and preserved in formalin-seawater solution.

"*Ceramium cingulatum*" collected in field and obtained in culture by Cormaci & Motta (1989) and preserved in formalin-seawater solution.

For microscopic observations, some specimens were stained on glass slides with 1% aqueous aniline blue acidified with dilute HCl which enhances pit connections.

OBSERVATIONS AND DISCUSSION

Ceramium giaccone sp. nov.

Diagnosis

Plantae epiphyticae; axibus erectis, substrato adfixis rhizoideis basalibus, usque ad 2mm altis, simplicibus, clavaeformibus, basi 70-80µm, medio 170-350µm diametro, apicibus attenuatis. Axes, articulis basalibus corticatione zonata exceptis, omnino corticati e cellulis isodiametricis (20-25µm) aequaliter distributis. (4-6) 8 cellulae pericentrales in quoque segmento. Quattuor cellulae corticalium filorum initiales (duo anteriores duoque posteriores) ex quaque cellula pericentrale generatae. In segmentis basalibus, unum obliquum corticale filum (1-2 cellulis) ab unaquaque cellula initiali anteriore effectum est, nullum a cellula initiali posteriore. In ceteris omnino corticatis segmentis, unaquaque cellula initialis anterior quattuor corticalia fila efficit: duo ascendentia longa et ramosa, duo descendentia breviora (1-3 cellulis). Unaquaque cellula initialis posterior quattuor corticalia fila efficit, sed contra, duo ascendentia brevia (1-3 cellulis), duo descendentia longiora et ramosa confluentia cum filis ascendentia ex inferiore segmento. Cellulae axiales, basi isodiametricae, medio usque ad duplo latiores quam altiores. Tetrasporangia non exserta, anteridia et procarpia ignota.

Type locality: Lachea Island (Catania, Italy) epiphytic on *Cystoseira saevageana* Hamel at 6 to 12m depth.

Holotype: CAT 519 tetrasporophyte; collected by G. Motta, 20 February 1987 at 12m depth.

Distribution: known from the type locality and Salina Island (Aeolian Islands), NW and W Mediterranean Sea (according to the authors) as *Ceramium cingulatum* (Fig. 1).

The species is dedicated to our friend and colleague Prof. Giuseppe Giaccone.

The thalli consist only of erect axes fixed by means of basal rhizoids, 1-2mm high, not ramified, clavate because of a marked swelling beginning immediately after the first 3-4 basal segments and growing more narrow,

(2) This is the first record of a sexual plant in this species.



Fig. 1: Distribution of *Ceramium giacconet* sp. nov. in the Mediterranean Sea: TL, Type locality; 1, Coppejans (1977); 2, Coppejans (1979); 3, Verlaque & Tiné (1981); 4, Ballesteros (1984); 5, Barceló & Boisset (1986); 6., this paper; 7, Abdelahad & Biliotti (1990); 8, Cecere (pers. comm.).

more or less abruptly, towards the apex (Fig. 2). While the diameter of the basal segments is quite constant (70–80 μm), the swelling of the thalli in the median parts is much more variable (170 to 350 μm) (Figs 3, 4).

The cortical cells, polygonal and isodiametric (20–25 μm), are distributed in a rather uniform way, completely covering the axial cells (Fig. 5), except in the basal segments, where they form only nodal cortical bands. (4–6) 8 pericentral cells per segment. Each pericentral cell cuts off two anterior and two posterior initials of cortical filaments. In the basal segments, which show a reduced number of pericentral cells, the posterior initials do not produce any cortical filament, while each anterior initial cuts off only one short cortical filament in the lateral direction (Fig. 7). The pericentral cells remain uncorticated. In all the rest of the thallus, with a continuous cortication, each anterior initial cuts off four (five) cortical filaments: two (three) acropetally, which are long and ramified; two basipetally, shorter (1–3 cells). Each posterior initial cuts off four cortical filaments too; but, on the contrary, the two acropetal are short (1–3 cells), the two basipetal are longer and ramified and cover the internodal zone being confluent with those coming from the inferior segment (Figs 8–9). The pericentral cells remain only partly corticated. The axial cells, more or less isodiametric near the base, are up to 2 times broader than long in the rest of the thallus (Fig. 6).

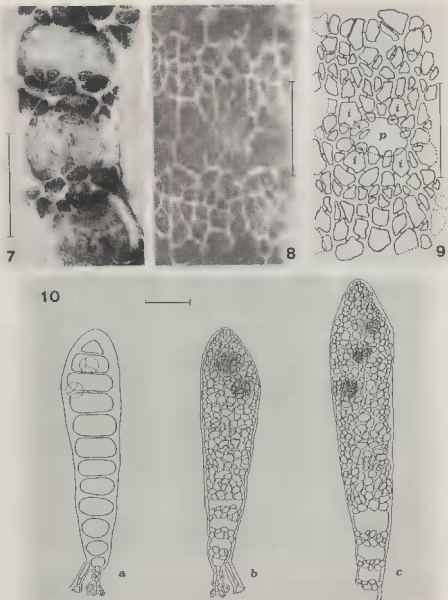
The tetrasporangia are cruciate-decussately divided⁽³⁾ and are immersed within the cortex at nodal level, arranged in more or less regular whorls (Fig. 2). Sexual plants are unknown.

⁽³⁾ tetraedrally divided in Coppejan's and Barceló's specimens.



Fig. 2-6: *Ceramium giacconei* sp. nov. (from Cormaci & Motta, 1989. Figs 2-4; bar equal to 0.5mm; Figs 5-6; bar equal to 200 μ m). 2: Habit of a mature tetrasporophyte, epiphytic on *Halopteris filicina* (Grateloup) Kützing. - 3: Habit of a specimen showing a marked swelling. - 4: Habit of a slightly swollen specimen. - 5: Suprabasal part of the thallus showing complete cortication. - 6: Optical section of Fig. 5 showing the axial cells.

On the contrary, *Ceramium cingulatum* shows the following significant differences from *Ceramium giacconei*:



Figs 7-10: *Ceramium giacconei* sp. nov. (bar equal to $100\mu\text{m}$). - 7: Nodal cortication in the basal segments. - 8: Detail of the cortication in the middle part of the thallus. - 9: Schematic drawing of Fig. 8 showing the origin of the cortical filaments on the basis of the observed pit connections. *p*: pericentral cell; *i*: initials of the cortical filaments. - 10: Tetrastorophyte, redrawn from the original papers in which it is reported as *Ceramium cingulatum* Weber-van Bosse: *a* and *b* from Coppejans (1983); *c* from Barceló & Boisset (1986).

1) Each anterior initial of the cortical filaments cuts off only two filaments acropetally; while each posterior initial does only two filaments basipetally (Figs. 12-13).

2) The descending cortical filaments are never confluent with those ascending from the inferior segment, so that an internodal uncorticated band is always present (Fig. 17, 19). Nodal cortication leaves longer internodal spaces in the basal parts of the thallus and shorter in the upper parts (Fig. 16). This character is well shown by Pham-Hoang (op. cit., fig. 2.165) (Fig. 19b, c), but not by Jaasund (op. cit., fig. 3). In fact, the specimens by him illustrated seem rather similar to *Ceramium giacconei*. The material from Tanzania should be re-examined.

3) Mature tetrasporangia clearly protruding (Figs 14-15).

Another difference, but with a minor taxonomic value (Dixon, 1960; Womersley, 1978), concerns the habit. *Ceramium cingulatum* shows creeping axes beginning erect in the terminal parts or producing erect branches (Figs 11 and 19a), whereas *Ceramium giacconei* shows only erect axes never ramified.

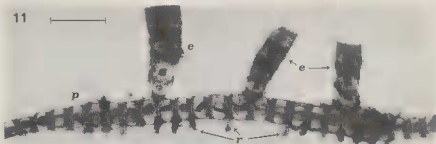
It appears probable that both the similarity in the habit of erect axes in these two species and the interpretation of Weber-van-Bosse's phrase "Interstitio angusto, multo minus alto quam zona in parte superiore ramorum ascendentium" as a continuous cortication in the upper parts of the thallus have led workers to mis-identify the thalli from the Mediterranean Sea as *Ceramium cingulatum*.

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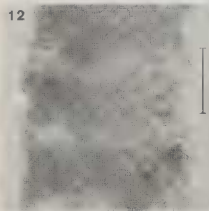
In conclusion, on the basis of the above mentioned considerations, the Mediterranean alga identified by various workers as *Ceramium cingulatum*, is here identified as *Ceramium giacconei*. Moreover, it seems likely that the records of *Ceramium cingulatum* by Verlaque & Tiné (1981) and Ballesteros

Figs 11-15: *Ceramium cingulatum* Weber-van Bosse. (Fig. 11, bar equal to 200 μ m; Fig. 12-15, bar equal to 50 μ m). - 11-12: specimen collected at station 49 (Makassar) by Weber-van Bosse. Rijksherbarium L. 8846 (in spirit). 11: Habit. *p* prostrate axis; *e* erect axes (fragments); *r* rhizoids. 12: Detail of the cortication of an erect axis. - 13: Schematic drawing of Fig. 12 showing the origin of the cortical filaments on the basis of the observed pit connections. *p* pericentral cell; *i* initials of the cortical filaments. 14: Detail of tetrasporangia (redrawn from Weber-van Bosse, 1923). - 15: Idem from the type material (original).

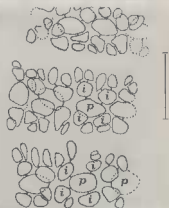
Figs 16-19 - *Ceramium cingulatum* Weber-van Bosse. (Fig. 16, bar equal to 0.5mm; Figs 17-19 b-c, bar equal to 50 μ m). - 16-18: specimen collected by Sartoni at Sar Uanle, Somalia. 16: Habitat of an erect axis; *a*, see Fig. 17. - 17: Detail of the part *a* of Fig. 16 showing the typical nodal cortication. - 18: Detail of male gametophyte showing spermatangia. - Fig. 19: Redrawn from Pham-Hoang (1969); *a* habit; *b* nodal cortication in a basal part of the thallus; *c* cortication in a median segment with tetrasporangia.



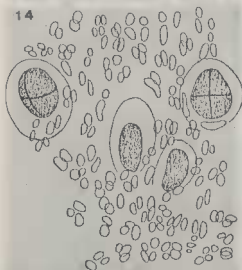
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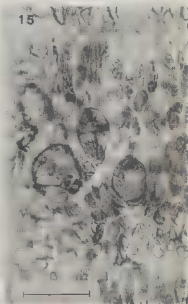
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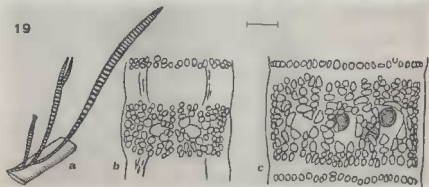
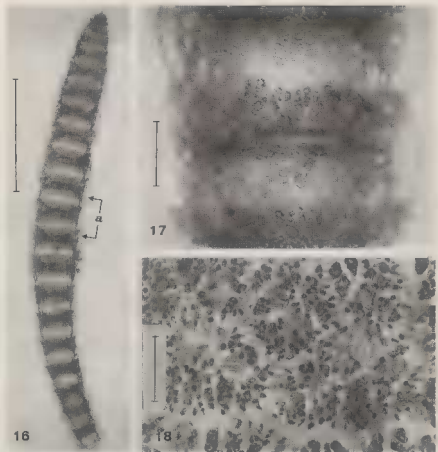


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(1984), the former marked by ? and the latter making reference to Coppejan's description (1977), should also be attributed to *Ceramium giacconeii*. Therefore, as far as known, *Ceramium cingulatum* does not occur in the Mediterranean Sea.

ACKNOWLEDGMENTS

We are grateful to the Curator of the Rijksherbarium for the loan of *Ceramium cingulatum* Weber-van Bosse; to Gianfranco Sartoni of the Dipartimento di Biologia Vegetale, University of Florence for the loan of *Ceramium cingulatum* from Somalia. This work was supported by a grant from the Italian Ministry of Public Education.

REFERENCES

- ABDELAHAD N. & BILIOTTI M., in press - *Ceramium cingulatum* Weber-van Bosse (Rhodophyta, Ceramiales): prima segnalazione per le coste laziali. *Inform. Bot. Ital.*
- ATHANASIADIS A., 1987 - *A survey of the seaweeds of the Aegean sea with taxonomic studies on species of the tribe Antithamnieceae (Rhodophyta)*. University of Gothenburg, Dept. of Marine Botany, 174 p.
- AYSEL V., GÜNER H., SUKATAR A. & ÖZTÜRK M., 1983-1984 - Checklist of Izmir Bay marine algae: I. Rhodophyceae. *Aegean Univ. Fac. Sci. J. Ser. B.* 7(1): 47-56.
- BALLESTEROS E., 1984 - Contribució al coneixement algològic de la Mediterrània espanyola, IV. *Fol. Bot. Misc.* 4: 29-33.
- BARCELÓ M.C., 1987 - *Estudi de la flora bentònica marina del País Valencià*. Tesi. Univ. Barcel·loaigu2na.
- BARCELÓ M.C. & BOISSET F., 1986 - Aportació a l'estudi de les algues del País Valencià. *Fol. Bot. Misc.* 5: 71-78.
- BOUDOURESQUE Ch. F., 1984 - Groupes écologiques d'algues marines et phytocénoses benthiques en Méditerranée nord-occidentale: une revue. *Giorn. Bot. Ital.* 118 (1-2) suppl. 2: 7-42.
- COPPEJANS E., 1977 - Végétation marine de l'île de Port-Cros (Parc National). XV. *Ceramium cingulatum* Weber-van Bosse nouvelle pour la Méditerranée, et quelques populations d'un *Ceramium* sp. à parasporocystes. *Biol. Jh. Dodonaea* 45: 51-61.
- COPPEJANS E., 1979 - Végétation marine de la Corse (Méditerranée). III. Documents pour la flore des algues. *Bot. Mar.* 22 (4): 257-266.
- COPPEJANS E., 1983 - Iconographie d'Algues Méditerranéennes. Chlorophyta, Phaeophyta, Rhodophyta. *Bibliotheca Phycologica* Bd 63, J.Cramer, Vaduz.
- CORMACI M. & MOTTA G., 1989 - Prima segnalazione di *Ceramium cingulatum* Weber-van Bosse (Rhodophyta, Ceramiales) in Italia e osservazioni sul suo ciclo biologico in coltura. *Anales Jard. Bot. Madrid* 46: 55-60.
- DIXON P.S., 1960 - Studies on marine algae of the British Isles: the genus *Ceramium*. *J. Mar. Biol. Ass. U.K.* 39: 331-374.
- FELDMANN-MAZOYER G., 1941 - *Recherches sur les Cérámiales de la Méditerranée*. Alger, 510 p.

- GALLARDO T., GOMEZ GARRETA A., RIBERA M.A., ALVAREZ M. & CONDE F., 1985 - A preliminary check list of Iberian benthic marine algae. *Real Jardin Botanico*, Madrid.
- GIACCONE G., 1968 - Specie nuove e interessanti di Rhodophyceae raccolte nel bacino orientale del Mediterraneo. *Giorn. Bot. Ital.* 102: 397-414.
- GIACCONE G., 1978 - Revisione della flora marina del mare Adriatico. *Parco marino di Miramare*, Trieste.
- GÓMEZ-MENOR J.M. & FUERTES LASAL E., 1982 - Contribución al estudio de las algas rojas de la isla de Tabarca (Alicante). *Collectanea Botanica* 13: 865-872.
- GÜVEN K.C. & ÖZTIG F., 1971 - Über die marinen Algen an den Küsten der Türkei. *Bot. Mar.* 14: 121-128.
- HAUCK F., 1885 - *Die Meeresalgen Deutschlands und Oesterreichs*. Leipzig. 575p.
- JAASUND E., 1970 - Marine algae in Tanzania III. *Bot. Mar.*, 13: 65-70.
- PHAM-HOANG H., 1969 - *Marine algae of South Vietnam*. Saigon, 557p.
- RIBERA M.A., 1984 - *Estudio de la flora bentonica marina de las Islas Baleares. Resumen de la tesis*. Univ. Barcel&oaigu2na.
- ROTH A.W., 1797 - *Catalecta botanica*. T. I. VIII + 244 p. Leipzig.
- SARTONI G., 1974 - Contributo alla conoscenza della flora algale bentonica di Sar Uanle (Somalia meridionale). *Giorn. Bot. Ital.* 108: 281-303.
- SCHIFFNER V., 1931 - Neue und bemerkenswerte Meeresalgen. *Hedwigia* 31: 139-205.
- SCHIFFNER V., 1938 - *Alge della Laguna, sez. I. In La Laguna di Venezia*, 3: 83-250. Venezia.
- VERLAQUE M., 1984 - Biologie des juvéniles de l'oursin herbivore *Paracentrotus lividus* (Lamarck): sélectivité du broutage et impact de l'espèce sur les communautés algales de substrat rocheux en Corse (Méditerranée, France). *Bot. Mar.* 27: 401-424.
- VERLAQUE M. & TINÉ J. 1981 - Marine vegetation of Toulon (Var, France): algae and seagrasses. *Thalassographica*, 4: 5-38.
- WEBER-VAN BOSSE A., 1923 - Liste des algues du Siboga. III. Rhodophyceae 2e partie: Ceramiales. *Siboga-Expeditie*, 59c: 310-392.
- WOMERSLEY H.B.S., 1978 - Southern Australian species of *Ceramium* Roth (Rhodophyta). *Austral. J. Mar. Freshwater Res.*, 29: 205-257.